

Hippity Hoppity

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Objective

From a given scenario, student will be able to write and solve multi-step equations which involve one or more of the following: two-steps, simplifying (combing like terms), distributive property, and/or variables on both sides. By doing so, the students will gain understanding of the meaning of a variable as an unknown (length of each hop), a coefficient as a multiplier (number of hops), constant (extra distance), and that equations represent an equivalent value on both sides.

General Description

The students are to determine the length of a typical “hop.” They will be asked to hop several times over a given distance. If the hops remain relatively consistent in length, then an equation can be written and solved to determine the length of each hop. Each of the various stations offers a different sequence of hops, and therefore, a different type of equation to be solved. At each station, the students will be conducting one or two sets of hops; one in which they stop short of the given distance, and/or one in which they finish past the given distance. Each Station on the handout offers a practice problem so the teacher may model the “hopping,” as well as the solving of the equations.

Modeling & Practice

There is an opportunity to model the appropriate type of equation at each station. No matter the level of the students, it is very important to discuss with them the meaning behind the variable (length of each hop), the coefficient (number of hops), and the constant (extra distance). It is equally important to stress that each side of the equation represents the same thing... total distance. Another critical concept to emphasize is that with the distributive property, the quantity inside the parenthesis is the repeated quantity. Have these conversations with the students, using the practice problems to conduct the discussion.

The Hopping Venue

You will need a hallway or large open space like a cafeteria or outdoor quad in which students will be able to hop. Using the masking tape, set out two parallel lines 10 to 20 feet apart. Measure this distance in advance of the lesson and announce this distance to the students in inches. You may conduct all Stations at one given distance, or establish four areas, one for each station. The students should be working in groups of equal ability for this lesson. For each Station they must determine a hopper (who will do the hopping). They may

Concepts

Writing & Solving Equations

Time: 1-4 hours depending on the level of the class. For introductory Algebra classes, each station can be given its own day. For more experienced Algebra classes, students can conduct all stations in one day.

Materials

Blue Masking Tape, Tape Measures, Student Handout, Hopping Venue

Preparation

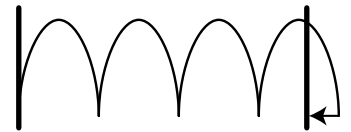
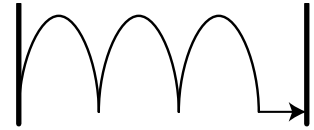
Choosing a Hopping Venue and taping off the pre-determined distances. Students should have exposure to, but not necessarily mastery of, solving equations.

Hippity Hoppity (continued)

change from station to station, but only one student should do the hopping at any given Station.

STATION 1 - Two-Step Equations

THE HOPPING: The student is to start at one of the lines of tape and hop until they are just shy of the other line. Another student is to measure the remaining (extra) distance in inches. These two values plus the total distance announced by the teacher are recorded on the handout for the “near hop,” since the student stopped short of the finish line.



The student is to do the same thing again, keeping the length of each hop consistent with the first set, until he or she is just past the second line. Again, a group partner will measure this extra distance. This second set of numbers will be recorded for the “far hop” since the student finished past the finish line. This time though, that distance is recorded as a negative value since it must be subtracted from the “hopping” distance to yield the true distance between the lines.

THE EQUATION: Each set (the near and the far) are two different equations. The students should write these separately, as with the practice problems. The values for x should be similar; identical values will probably not occur since the students more than likely are not hopping exactly the same distance each time.

STATION 2 - Simplifying/Combining Like Terms

THE HOPPING: The student is to start at one of the lines of tape, hop several times, take two steps and then continue hopping. Another student is to measure the remaining (extra) distance in inches. The steps in between the hops are to be taken heel-to-toe, and the combined distance of the two steps is to be recorded in inches. The example given is for a “near hop,” in which the student hopped three times, took two steps with a 9” foot (18” combined inches), hopped 4 more times, stopping 5 inches short of the line.



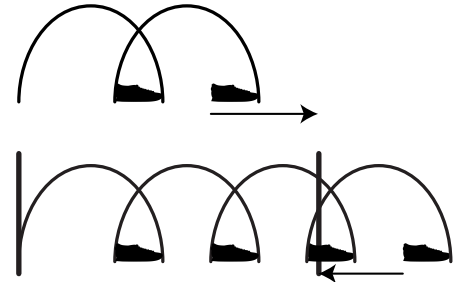
The student is to do the same thing, but until he or she is just past the second line. There should be two added steps along the way. For variety, be sure that the number of hops the student takes before the steps is different than in the first set. Again, a group partner will measure this extra distance. This second set of numbers will be recorded for the “far hop.”

THE EQUATION: The teacher should pay particular attention in pointing out that the constants are distances in inches, therefore they can be “combined” which “simplifies” our equation. The coefficients represent the number of hops (not number of inches) so while they may be combined with each other, they may not be combined with the constants. Then we can add or subtract the constant from both sides because it makes sense to add or subtract inches to or from inches. When it comes time for dividing the constant, share with the students that the units are in inches per hop...which is what we are trying to find!

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STATION 3 - Distributive Property

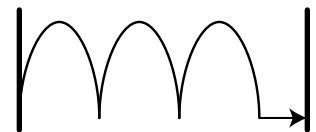
THE HOPPING: The student is to start at one of the lines of tape, hop once and then take one step back. This process of one Hop with one Step is repeated until the student is just shy of just past the line. Another student is to measure the remaining (extra) distance in inches. The steps between the hops are to be taken heel-to-toe as with Station 2. The example given is for a “far hop,” in which the student repeated the Hop/Step Back process four times, finishing 20 inches past the line. The student is to do the same thing (Hop/Step Back repeatedly), but until he or she is just shy of the second line. A group partner will measure and record this extra distance.



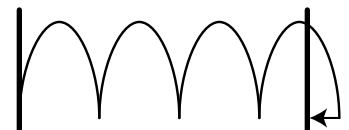
THE EQUATION: The teacher should pay particular attention in pointing out that the expression in the parentheses is the combined distance of "Hop minus Step Back", and that the coefficient of this quantity ("The number in front of the parentheses") is the number of times this distance is repeated. The reason we distribute to both terms within the parentheses is that we have each term the same number of times. In other words, we do not have 4 hops with only one 10-inch step back. We actually have 4 hops AND 4 step backs.

STATION 4 - Variables on Both Sides

THE HOPPING: The student is to start at one of the lines of tape, hop until they are just shy of the line. A fellow student will measure the extra distance. The student is to start again, but this time the hops continue past the line. This extra distance is measured as well. The example shows this explicitly.



THE EQUATION: The teacher should pay particular attention in pointing out that both sets of hops, plus or minus the extra distances, finished at the same total distance. Therefore, we can set the two expressions equal to each other. In the example, when we subtract $3x$ from both sides, we can show in the diagram how we eliminate the first three hops in both sets, and the diagram will show that ONE hop minus 17 inches does EQUAL the 14 inches on the other side of the line. Then we add the 17 inches to both sides to get a complete hop!



STATION 5 - Bonus: Negative Coefficients

This bonus questions offers students to work with negative coefficients. A potential equation at this station would look something like: $-3x - 10 + 15x + 8 = 154$

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Assessment

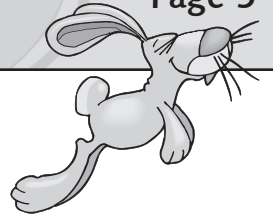
When the lesson is completed there are five questions offered for assessing student understanding. The first three evaluate skill acquisition (i.e. Can they solve basic equations?). Number 4 asks the students to demonstrate understanding of the terms of an equation within a given context: # of Hops = 4, Extra Distance = 12" past the line, Total Distance = 88", Length of Each Hop = 25" (solve for x). Number 5 tests the students' abilities in writing an equation for a given scenario, and in solving the equation in order to find a value relating to the scenario.

Opportunity for Differentiation

The level of thinking as well as the difficulty of the equations increases with each station of this lesson. If you so choose, rather than having all students compete all stations you can...

1. Delegate one station per group, and assign the more complex equations to the higher performing groups.
2. Assign Station 1 to all groups, but have only the advanced students also do the more complex stations.
3. Have all students attempt all stations, but hold students accountable only for those stations that you deem are of the appropriate rigor for each student. In other words, while a weaker student may only be graded on the easier stations, a more advanced student may be graded on the more complex stations, but at least all students have exposure to all models.





Hippity Hoppity

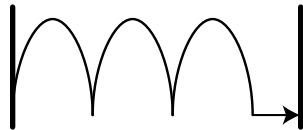
You will be approximating the length of a hop by counting the number of times it takes you to hop a given distance. Of course, you probably will not hop the exact distance, so there will be some extra measurements factored in. You will conduct your measurements at four different stations. Within your group, each member will be designated as the Hopper for one of the stations. The Hopper will conduct two series of hops: a near hop in which the Hopper stops before the finish line and a far hop in which the Hopper stops beyond the finish line. Each station requires a different type of equation to calculate the length of the hops. Follow the directions and samples carefully.

Station 1 (Hop - Hop - Hop)

Near Hop: Hop until you are just shy of the finish line. Record the number of hops and measure the remaining distance as "extra."

Far Hop: Hop until you are just past the finish line. Record the number of hops and then measure the distance back to the finish line. (This extra distance should be negative.)

EXAMPLE (NEAR HOP)



Let x = Length of each hop
 # of Hops = 3
 Extra Distance = 24 "
 Total Distance = 150 "
 Hop Length =

Equation:

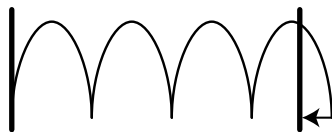
$$\begin{array}{r} 3x + 24 = 150 \\ -24 \quad -24 \\ \hline 3x = 126 \\ \div 3 \quad \div 3 \\ \hline x = 42 \end{array}$$

IN WORDS... 3 hops plus 24 inches is the same distance as 150 inches.

SO... 3 hops is the same distance as 126.

THEREFORE... each hop is 42 inches long.

EXAMPLE (FAR HOP)



Let x = Length of each hop
 # of Hops = 4
 Extra Distance = 17 "
 Total Distance = 150 "
 Hop Length =

Equation:

$$4x - 17 = 150$$

IN WORDS...

SO...

THEREFORE...

Hippity Hoppity (continued)

Station 1 (continued)

STATION (NEAR HOP)



Equation:

IN WORDS...

SO...

THEREFORE...

Let $x =$ _____

of Hops = _____

Extra Distance = _____

Total Distance = _____

Hop Length =

STATION (FAR HOP)



Equation:

IN WORDS...

SO...

THEREFORE...

Let $x =$ _____

of Hops = _____

Extra Distance = _____

Total Distance = _____

Hop Length =

Hippity Hoppity (continued)

Station 2 (Hop – Walk – Hop)

Near Hop: Hop several times and then take two steps (Each step is equivalent to your foot length, heel to toe.). Continue by hopping until you are just shy of the finish line. Record the number of hops and measure the remaining distance as “extra.”

Far Hop: Hop a different number than you began with for the near hop combination. Walk the identical two steps and then hop until you just pass the finish line. Record the number of hops and measure the distance back to the finish line.

EXAMPLE (NEAR HOP)



Equation:

$$3x + 18 + 4x + 5 = 205$$

IN WORDS... 3 hops plus 18 inches plus 4 more hops plus 5 more inches is the same distance as 205 inches.

SO...

SO...

THEREFORE...

Let x = Length of each hop

of 1st Hops = 3

Length of Step = 9"

of 2nd Hops = 4

Extra Distance = 5"

Total Distance = 205"

Hop Length =

STATION (FAR HOP)



Equation:

IN WORDS...

SO...

SO...

THEREFORE...

Let x = _____

of 1st Hops = _____

Length of Step = _____

of 2nd Hops = _____

Extra Distance = _____

Total Distance = _____

Hop Length =

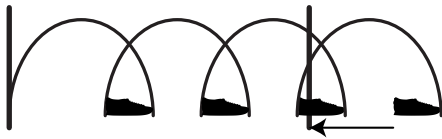
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Station 3 (Hop – Step Back)

Near Hop: After each hop, take one step back (A step is equivalent to your foot length, heel to toe.). Continue this until you are just shy of the finish line. Record the number of hops, the step length (as a negative number), and the extra to the finish line.

Far Hop: Repeat the near hop process until you are just past the finish line. Record the number of hops and then measure the distance back to the finish line.

EXAMPLE (FAR HOP)



Let x = Length of each hop
 # of Hops/Steps = 4
 Length of Step = 10 "
 Extra Distance = 20 "
 Total Distance = 70 "
 Hop Length =

Equation:

$$4(x - 10) - 20 = 70$$

IN WORDS... A hop minus 10 inches, four times, minus 20 more inches is the same distance as 70 inches.

SO...

SO...

SO...

THEREFORE...

STATION (NEAR HOP)

Let x = _____
 # of Hops/Steps = _____
 Length of Step = _____
 Extra Distance = _____
 Total Distance = _____
 Hop Length =

Equation:

IN WORDS...

SO...

SO...

SO...

THEREFORE...

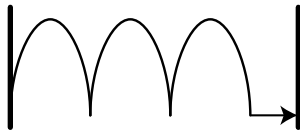
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Station 4 (Equal Distances)

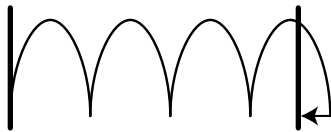
Near Hop & Far Hop: Follow the directions for Station 1.

The difference here is that you do not know the distance from start to finish. However, you do know that the total distance of each series of hops is equal. Write an equation as shown below and solve.

EXAMPLE (NEAR HOP)



(FAR HOP)



Equation:

$$3x + 14 = 4x - 17$$

Let x = Length of each hop

of Near Hops = 3

Extra Near Distance = 14"

of Far Hops = 4"

Extra Far Distance = 17"

Total Distance =

IN WORDS... 3 hops plus 14" is the same distance as 4 hops minus 17".

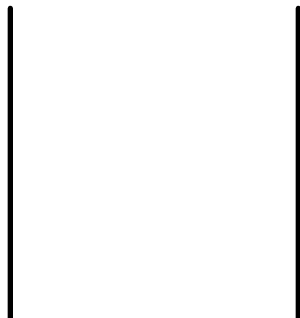
SO...

SO...

THEREFORE...

STATION

(NEAR HOP)



(FAR HOP)

Let x =

of Near Hops =

Extra Near Distance =

of Far Hops =

Extra Far Distance =

Total Distance =

Equation:

IN WORDS...

SO...

SO...

THEREFORE...

Station 5 (Bonus)

For a challenge, try this: From the starting line, make several hops backwards (away from the finish line), and then take a step backwards (still away from the finish line). Then hop forward until you are just shy of the finish line. Walk (steps) to the finish line. Establish this equation and solve for the length of your hop.

Hippity Hoppity: Assessment

Solve for x.

1) $3x + 8 + 7x = 28$

2) $2(x + 4) = 34$

3) $3x + 11 = 8x - 9$

4) The equation below represents a "Hopping Scenario." Identify each of the attributes of the scenario.

$$4x - 12 = 88$$

Identify the Following:

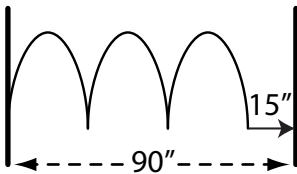
of Hops = _____

Extra Distance = _____

Total Distance = _____

Hop Length = _____

5) Write and solve an appropriate equation for the given "Hopping Diagram" below.



Hops = 3

Extra Distance = 15"

Total Distance = 90"

Equation = _____

Hop Length = _____